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Volume Title: Dating Postwar Business Cycles: Methods and Their Application to Western Germany, 1950-67

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Volume Publisher: UMI

Volume ISBN: 0-87014-212-7

Volume URL: http://www.nber.org/books/mint70-1

Publication Date: 1970

Chapter Title: Deviation cycles

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Chapter URL: http://www.nber.org/chapters/c3265

Chapter pages in book: (p. 12 - 14)

Deviation cycles

Deviation cycles are based on the adjustment of indicators for their upward trends. Hence, they encounter the common objection to reliance on trend-adjusted series, the unavoidable arbitrariness involved in selecting the trend curve. Dates of cycle turns and even the existence of cycles depend on the definition of the trend. The objection is valid and is the reason for employing a second entirely different procedure, the identification of cycles in growth rates. Thus the results obtained with one method are checked against those obtained with the other.

The arbitrariness of the trend adjustment is also reduced, as far as possible, by applying the same formula to all twenty-one indicators. This could not have been done with fitted trends because of the diversity of long-run movements among indicators. In some instances a series' movements have shifted over time and two or more trends would have had to be fitted to a single indicator. Since it is unadvisable to fit several trends to a period of only eighteen years and even more unadvisable to adjust different indicators in different ways, we decided on using a long-term moving average which is flexible enough to cope with the diversity of trends. In order to iron out cyclical swings a term of six to seven years is required. We chose a seventy-five-month moving average as a convenient figure that fits the requirement. The missing thirty-seven months at either end of the moving average are supplied with the help of its average rate of change during the first two years and the last two years for which it is available. This method of extrapolation implies that the series proper is assumed to repeat in the period not covered by the data, its pattern during the first years and the last years which are covered by the data. The trends are shown in the top panels of Charts A-1 to A-21. The only indicators which show horizontal trends are inventory changes and short-term lending changes.[18]

The percentage deviations of the series from their moving average trends represent the deviation cycles of the indicators whose turning points are to be determined (the second panels on Charts A-1 to A-21).

The turning points have been selected by a new objective method, a computer program developed at the NBER by Gerhard Bry and Charlotte Boschan.[19]

[18]Even these two series have been fitted with a trend in order to measure their movements in the same fashion as those of the other indicators.

[19]Gerhard Bry and Charlotte Boschan, *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs*, New York, NBER, forthcoming.

This method consists, essentially, in first identifying major cyclical swings, then delineating the neighborhoods of their maxima and minima, and finally narrowing the search for turning points to specific calendar dates. All procedures are performed on seasonally adjusted data.

This stepwise approach to the selection of turns is necessary because most time series are much too choppy for direct mechanical selection of cyclical maxima and minima. Such a procedure would, instead, give a large number of highs and lows most of which would indicate only a brief fluttering of the data rather than a cyclical turn. For this reason the existence of cycles must first be determined in a smoothed form of the series before the precise date can be selected in the unsmoothed data.

The first curve from which turning points are determined, after adjustment for extreme values, is a twelve-month moving average. This is a convenient means for eliminating fluctuations of subcyclical duration or of very shallow amplitudes. The rule for selecting turning points is: any month whose value is higher than those of the five preceding months and the five following months is regarded as the date of a tentative peak; analogously, the month whose value is lower than the five values on either side is regarded as the date of a tentative trough. These tentative turns are tested for compliance to a set of constraint rules with respect to alternation of phases and duration of phases and cycles.

The next step in the process is the determination of tentative cyclical turns on the Spencer curve of the original data. The Spencer curve is selected as the next intermediary curve because its turns tend to be closer to those of the original data than those of the twelve-month moving average.[20]

In principle, the program searches, in the neighborhood (defined as ± five months) of the turns established on the twelve-month moving average, for like turns on the Spencer curve. That is, in the neighborhood of peaks, it searches for the highest of the eleven points on the Spencer curve; in the neighborhood of troughs, for the lowest. The Spencer curve turns thus located are then subjected to several tests.

They are rejected when they are (1) less than six months from either end of the series; (2) like turns and less than fifteen months apart; and (3) like turns without an intervening opposite turn.

The accepted turns in the Spencer curve provide the basis for the next step in the search for turns in the original data. In this step the series is smoothed by a three- to six-month moving average. The exact number of months depends on the time it takes for the cyclical component to exceed the irregular component in the particular series analyzed.

[20]The Spencer curve is a complex fifteen-month graduation formula, a weighted moving average with the highest weights in the center and negative weights at either end. This ensures that the curve follows the data closely. It has approximately the flexibility of a five-month moving average but is much smoother.

The method of deriving turning points in this moving average is practically the same as that for the Spencer curve. The highest peaks on the moving average curve within a span of five months from the dates of the peaks on the Spencer curve are selected and, correspondingly, so are the troughs.

The last step of the procedure is to find the peak and trough values in the unsmoothed data which correspond to the short-term moving average turns previously established. This search is again analogous to the previous ones. The program establishes the highest values in the unsmoothed data within a span of ± five months from the peak in the short-term moving average curve; correspondingly, the lowest value of the unsmoothed data in the neighborhood of moving average troughs is established.[21]

Having again eliminated any turns not complying to the rules, the remaining ones are accepted as the final turning points of the series.[22]

We now turn to the deviation cycles on Charts A-1 to A-21. The first impression is that most indicators move in clear-cut cyclical swings with unmistakable turning points. There is no doubt that a cyclical process was going on in almost all types of economic activities. Sharply defined cycles of particularly large amplitudes are found in indicators for unemployment, job vacancies and stock prices. Cycles of smaller amplitude but of outstanding smoothness are characteristic of series measuring the number of employees, investment in plant and equipment, current and real GNP. At the other end of the spectrum are a few indicators whose large erratic movements obscure to some extent the cyclical ones. This holds mainly for construction and for changes in lending. Prices have been stable over some periods so that the dating of turning points is sometimes difficult.

The crucial aspect of the turning points in deviation cycles of individual indicators is, of course, their consensus in time. This will be described in a later section.

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[21] To be more precise, the span varies between four and six months, depending on the term of the moving average.

[22] In five instances (one in each of five series) the program selects a month other than the highest or lowest one as turning point. The difference between the standings of the series in the selected and in the extreme month is less than 1 per cent in three of these cases. The reason for preferring the second highest or lowest point is its occurrence in a bank of high or low standing, in contrast to an isolated maximum or minimum.

Opinions will differ regarding the acceptance or rejection by the program of borderline cases, i.e., relatively mild cycles. Since drawing the line here is a matter of subjective judgment and since the turns selected by the program seem sensible to us, we have not attempted any modifications.

It should be noted that the computer program does not utilize directly any information on the amplitude of cycles. The only way in which amplitude plays a role is that the moving averages, especially the initial, twelve-month moving average, tend to iron out minor swings (though only if they are also brief).